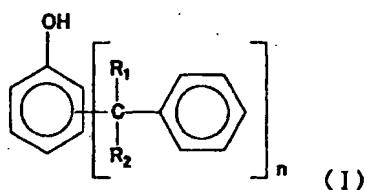


Claims

1. A thermosetting resin composition comprising:

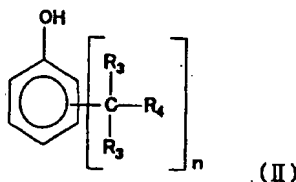
- (A) a phenol-modified cyanate ester oligomer that
5 is the reaction product of (a) a cyanate compound containing two or more cyanato groups in a single molecule, and (b) a phenol compound containing at least one member selected from a phenol compound represented by the formula (I):



10

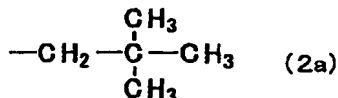
wherein R₁ and R₂ independent of each other represent a hydrogen atom or a methyl group, and may be respectively the same or different from each other, and n represents an integer of 1 or 2,

- 15 and a phenol compound represented by the formula (II):



20

wherein R₃ independent of each other represent a hydrogen atom or a methyl group, and may be respectively the same or different from each other, R₄ represents an alkyl group selected from a methyl group, an ethyl group or a group (2a):



- and n represents an integer of 1 or 2,
and which is obtained by reacting such that a blending
25 equivalence ratio of (b) hydroxyl group / (a) cyanato group is within a range of 0.01 to 0.3, and a monomer conversion

rate of the cyanate compound (a) containing two or more cyanato groups in a single molecule is 20 to 70%;

(B) an epoxy resin containing two or more epoxy groups within a single molecule; and,

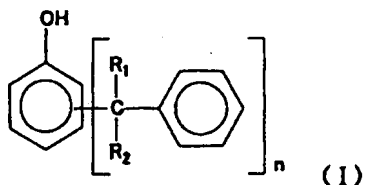
5 (C) at least one member selected from a metal salt of a di-substituted phosphinic acid and a phosphazene compound as a flame retardant.

2. A thermosetting resin composition according to
10 claim 1 wherein the phenol-modified cyanate ester oligomer of (A) is a phenol-modified cyanate ester oligomer obtained by reacting with phenol compound (b) so that the monomer conversion rate of the cyanate compound (a) containing two or more cyanate groups in a single molecule
15 is 45 to 65%.

3. A thermosetting resin composition comprising: (A1) a cyanate compound containing two or more cyanato groups in a single molecule, (B) an epoxy resin containing two or
20 more epoxy groups within a single molecule, (C) at least one member selected from a metal salt of a di-substituted phosphinic acid and a phosphazene compound, (D) a silicone polymer containing at least one member of siloxane unit selected from a tri-functional siloxane unit represented
25 by the formula: $\text{RSiO}_{3/2}$ (wherein R represents an organic group, and the R groups in the silicone polymer may be mutually the same or different) and a tetra-functional siloxane unit represented by the formula: $\text{SiO}_{4/2}$, having a degree of polymerization of 7,000 or less, and having one
30 or more functional groups on its terminals that react with hydroxyl groups, and (E) an inorganic filler.

4. A thermosetting resin composition according to
35 claim 3 wherein (A1) a cyanate compound containing two or more cyanato groups in a single molecule is a phenol-modified cyanate ester oligomer that is the reaction

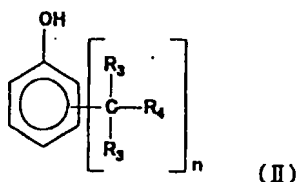
product of (a) a cyanate compound containing two or more cyanato groups in a single molecule, and (b) a phenol compound containing at least one member selected from a phenol compound represented by the formula (I):



5

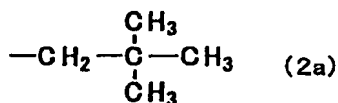
wherein R_1 and R_2 independent of each other represent a hydrogen atom or a methyl group, and may be respectively the same or different from each other, and n represents an integer of 1 to 3,

10 and a phenol compound represented by the formula (II):



15

wherein R_3 independent of each other represent a hydrogen atom or a methyl group, and may be respectively the same or different from each other, R_4 represents an alkyl group selected from a methyl group, an ethyl group or a group (2a):



and n represents an integer of 1 or 2,

and which is reacted such that a blending equivalence ratio of (b) hydroxyl group/ (a) cyanato group is within a range of 0.01 to 0.3, and the monomer conversion rate of the cyanate compound (a) containing two or more cyanato groups in a single molecule is 20 to 70%.

25

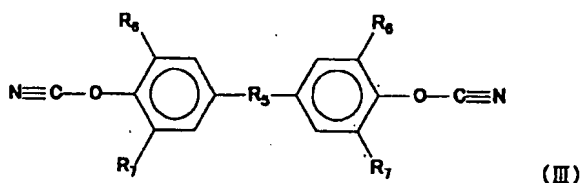
5. A thermosetting resin composition according to any of claims 1 to 4 wherein the number average molecular

weight of the phenol-modified cyanate ester oligomer of (A) or the cyanate compound containing two or more cyanato groups in a single molecule of (A1) is 380 to 2500.

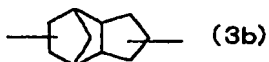
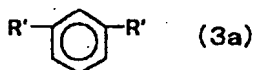
- 5 6. A thermosetting resin composition according to any of claims 1 to 4 wherein the number average molecular weight of the phenol-modified cyanate ester oligomer of (A) or the cyanate compound containing two or more cyanato groups in a single molecule of (A1) is 400 to 1600.

10

7. A thermosetting resin composition according to any of claims 1, 2 or 4 wherein the phenol-modified cyanate ester oligomer of (A) or the cyanate compound containing two or more cyanato groups in a single molecule of (A1) contains at least one member of cyanate compound selected from compounds represented by the formula (III):



- wherein R₅ represents an alkylene group having 1 to 3 carbon atoms that may or may not be substituted with a halogen, the formula (3a) or formula (3b):
- 20

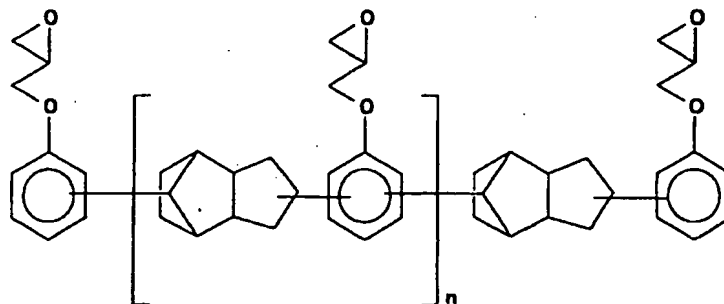


and R₆ and R₇ represent hydrogen atoms or alkyl groups having 1 to 3 carbon atoms and R' represent alkyl groups having 1 to 4 carbon atoms.

25

8. A thermosetting resin composition according to any of claims 1 to 4 wherein the epoxy resin containing two or more epoxy groups in a single molecule of (B) contains at

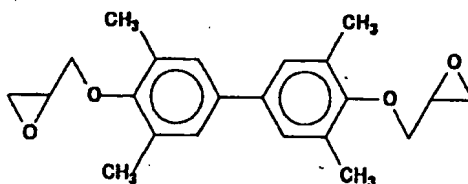
least one member selected from an epoxy resin derived from a dicyclopentadiene-phenol heavy addition product containing a dicyclopentadiene backbone represented by the formula (IV):



(IV)

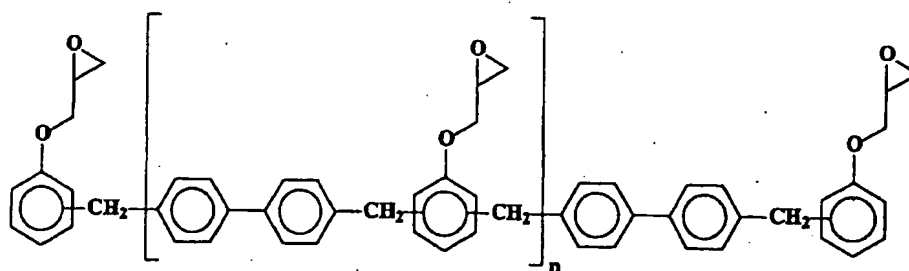
5

wherein n represents 0 or an integer,
a biphenyl epoxy resin represented by the formula (V):



(V)

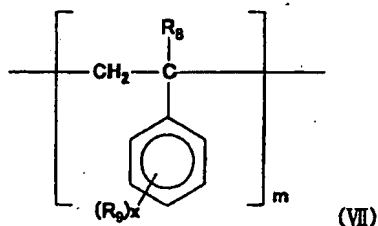
and a biphenyl aralkyl Novolak epoxy resin represented by
10 the formula (VI):



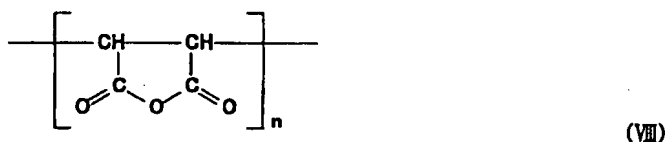
(VI)

wherein n represents an integer of 1 to 10.

9. A thermosetting resin composition according to any
15 of claims 1 to 4 that additionally contains a copolymer
resin containing a monomer unit represented by the formula
(VII):



wherein R_8 represents a hydrogen atom, halogen atom or monovalent hydrocarbon group having 1 to 5 carbon atoms, R_9 respectively and independently represents a halogen atom, monovalent aliphatic hydrocarbon group having 1 to 5 carbon atoms or monovalent aromatic hydrocarbon group, x represents an integer of 0 to 3, and m represents a natural number, and a monomer unit represented by the formula (VIII):

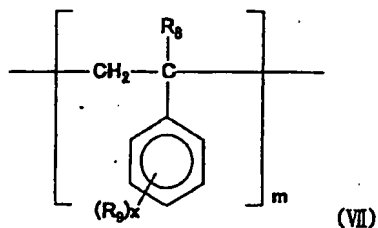


wherein n represents a natural number.

10. A thermosetting resin composition according to claim 3 or 4 that is used by surface treating the inorganic filler of (E) with the silicone polymer of (D) containing at least one member of siloxane unit selected from a tri-functional siloxane unit represented by the formula: $\text{RSiO}_{3/2}$ (wherein, R represents an organic group, and the R groups in the silicone polymer may be mutually the same or different) and a tetra-functional siloxane unit represented by the formula: $\text{SiO}_{4/2}$, having a degree of polymerization of 7,000 or less, and having one or more functional groups on its terminals that react with hydroxyl groups.

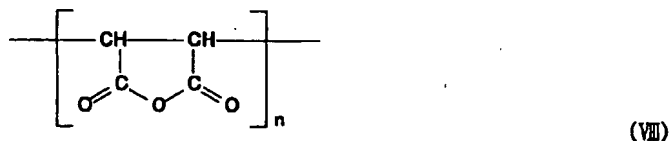
11. A thermosetting resin composition according to any of claims 1 to 4 that additionally contains a copolymer resin containing a monomer unit represented by the formula

(VII):



wherein R_8 represents a hydrogen atom, halogen atom or hydrocarbon having 1 to 5 carbon atoms, R_9 respectively and independently represents a halogen atom, an aliphatic hydrocarbon group having 1 to 5 carbon atoms or an aromatic hydrocarbon group, x represents an integer of 0 to 3, and m represents a natural number,

and a monomer unit represented by the formula (VIII):

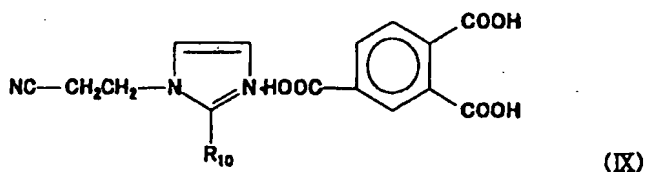


wherein n represents a natural number.

12. A thermosetting resin composition according to any of claims 1 to 4 that additionally contains as a curing accelerator (G) at least one member selected from the group consisting of organometallic salts and organometallic complexes of iron, copper, zinc, cobalt, nickel, manganese and tin, and an imidazole compound and acid addition salts thereof.

13. A thermosetting resin composition according to any of claims 1 to 4 that additionally contains as curing accelerator (G) at least one member selected from the group consisting of organometallic salts and organometallic complexes of iron, copper, zinc, cobalt, nickel, manganese and tin, and an imidazole compound and acid addition salts thereof represented by the formula

(IX):



wherein R₁₀ represents an alkyl group having 1 to 11 carbon atoms or a benzene ring.

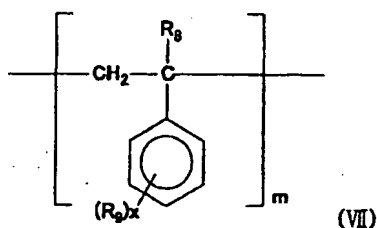
5

14. A thermosetting resin composition according to any of claims 1 to 4 that additionally contains as an antioxidant (H) one member of phenol-based antioxidant or organosulfur compound-based antioxidant.

10

15. A thermosetting resin composition according to claim 1 containing: 25 to 300 parts by weight of (B), 10 to 150 parts by weight of (C),

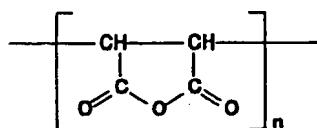
10 to 200 parts by weight of a copolymer resin (F) containing a monomer unit represented by the formula (VII):



wherein R₈ represents a hydrogen atom, halogen atom or hydrocarbon having 1 to 5 carbon atoms, R₉ respectively and independently represents a halogen atom, an aliphatic hydrocarbon group having 1 to 5 carbon atoms or an aromatic hydrocarbon group, x represents an integer of 0 to 3, and m represents a natural number,

20

25 and a monomer unit represented by the formula (VIII):



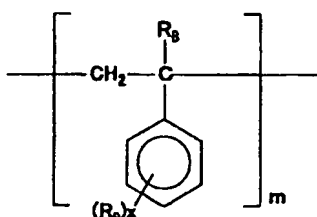
(VIII)

wherein n represents a natural number,

0.1 to 5 parts by weight as the total weight of at least one member selected from the group consisting of organometallic salts and organometallic complexes of iron, copper, zinc, cobalt, nickel, manganese and tin, and an imidazole compound and acid addition salts thereof as curing accelerator (G), and 0.1 to 20 parts by weight of at least one member of phenol-based antioxidant or organosulfur compound-based antioxidant as antioxidant (H) based on 100 parts by weight of (A).

16. A thermosetting resin composition according to claim 3 containing: 25 to 300 parts by weight of (B), 10 to 150 parts by weight of (C), 0.025 to 60 parts by weight of (D), 50 to 300 parts by weight of (E),

10 to 200 parts by weight of a copolymer resin (F) containing a monomer unit represented by the formula (VII):



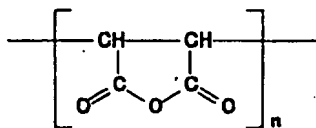
(VII)

20

wherein R₈ represents a hydrogen atom, halogen atom or hydrocarbon having 1 to 5 carbon atoms, R₉ respectively and independently represents a halogen atom, an aliphatic hydrocarbon group having 1 to 5 carbon atoms or an aromatic hydrocarbon group, x represents an integer of 0 to 3, and m represents a natural number,

25

and a monomer unit represented by the formula (VIII):



(VIII)

wherein n represents a natural number,
and

- 0.1 to 5 parts by weight as the total weight of at
5 least one member selected from the group consisting of
organometallic salts and organometallic complexes of iron,
copper, zinc, cobalt, nickel, manganese and tin, and an
imidazole compound and acid addition salts thereof as
curing accelerator (G),
10 based on 100 parts by weight of (A1).
17. A prepreg obtained by producing a varnish from a
thermosetting resin composition according to any one of
claims 1 to 4, impregnating on a base material and drying.
15
18. A metal-clad laminated board obtained by producing
a varnish from a thermosetting resin composition according
to any one of claims 1 to 4, impregnating the varnish on a
base material, curing the impregnated base material till
20 B-stage to form a prepreg, and layering and hot pressing
one or a plurality of the prepreg with a metal foil on one
side or metal foils on the top and bottom to form a metal-
clad laminated board.
- 25 19. A wiring board obtained by producing a varnish from
a thermosetting resin composition according to any one of
claims 1 to 4, impregnating the varnish on a base material,
curing the impregnated base material till B-stage to form
a prepreg, layering and hot pressing one or a plurality of
30 the prepreg with a metal foil on one side or metal foils
on the top and bottom to form a metal-clad laminated board,
and forming circuits on the metal-clad laminated board.